Framework for promoting social interaction and physical activity in elderly people using gamification and fuzzy logic strategy

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Agenda

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- Objective
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Introduction

• Population over 65 years in the United States is projected to increase from 18% to 26% and in the world from 9% to 16% by 2050 [1].

• Elderly people spend more time at their home than any other family members [5].

• Thermostats are used in 85% of residential buildings in the United States [6].

• New household products and applications are appearing due to advances in technology

• e-Health applications: Improve quality of life by promoting routine exercises.

• Elderly people failed in adopting new technologies due to lack of technological skills causing social isolation [4].

Introduction

- The acceptance of a product relies on personality traits [7,8].
- Gamification within a device may increase enjoyment in elderly users [9].
- Gamification with fuzzy logic has been proved to be useful in the decision-making process, such as profiling the type of user for the personnel selection process [18].
- Nevertheless, to the best of our knowledge, applying a gamification strategy based on fuzzy logic and the type of personality to develop a tailored product has not been studied previously.
### Personality traits in e-Health applications for elderly users [7,8]

<table>
<thead>
<tr>
<th>Trait</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Neuroticism (N)</td>
<td>They are not attracted to learn and try new things.</td>
</tr>
<tr>
<td>Agreeableness (A)</td>
<td>They are not attracted to technology; however, some of them are barely attracted to learn new things.</td>
</tr>
<tr>
<td>Openness (O)</td>
<td>Can or cannot be attracted to use Internet</td>
</tr>
<tr>
<td>Conscientiousness (C)</td>
<td>Attracted to learn and engage in activities, but they require to be convinced on the usefulness of the technology.</td>
</tr>
<tr>
<td>Extraversion (E)</td>
<td>They are extremely attracted to learn and try new things. They are a pro-technology user.</td>
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Propose a strategy that promotes regular physical activities and social interaction by considering the elderly's personality traits, the use of gamification techniques in mobile interfaces and the connected thermostat, to teach, engage, and motivate them to have a healthier lifestyle.
Current Solution

ENABLE project
Safety and assistive technologies for monitoring and controlling bath, temperature and gas stove.

Silver Promenade
Video game that simulated real-life activities.

2003 2008 2012 2017

UbiFit Garden
On-body sensing, activity inference and mobile to promote physical activity.

Spirit50
Online application for elderly people to promote physical activity.

https://www.consolvo.org/ubift


Proposed Solution

Develop a framework that considers the type of personality using a gamification strategy based on fuzzy logic to propose a tailored Human Machine Interface.
Methodology

Collection of data from books, journals and proceedings publications:

- The collected data was gathered from surveys, interviews and meta-analysis
- Gamification elements in e-Health applications for the elderly.
- Types of Gamification frameworks.
- Personalities for elderly people regarding their attitude, engagement, and knowledge about using the Internet for health purposes.
- The evaluation and metrics used in those publications to validate the HMI.
Framework
1. Knowledge base phase

This step gathers all the information from the literature review.

Analyzes the types of personalities, as well as the effects of the application, and the gamification elements used in e-Health applications for elderly.

Gamification is the use of game elements in non-game contexts to improve user experience and engagement [3,4,9-16]
Knowledge base phase

Gamification elements

Intrinsic:
• Challenges
• Progress bar
• Social sharing
• Feedback

Extrinsic:
• Badges
• Rewards
• Points
• Leaderboards

Motivational affordances [3]
Intrinsic:
Challenges, progression, feedback, choice, quest and social sharing
Extrinsic:
Badges, rewards, points, incentives, and leaderboards

Barriers [3]
Physical and activity barriers: related to osteoporosis, back pain, knee issues or injuries.
Mental barriers: related to confidence, time constraints, fear of complicating health conditions or being ridiculed by others

Usability problems in interfaces [17]
They prefer big, thick and clear font, control and contrast setting, video conference, and a lower game speed due to their dexterity and maneuverability.
2. Fuzzy logic phase

L. Zadeh (1965) proposed a fuzzy set theory that models uncertainty based on linguistic variables related to human reasoning. It does not require a mathematical model of the real system to develop the set, but the experts' knowledge to propose the system [19,20].

This step analyzes the effects of the game to propose the gamification elements that best fit the user type.

The fuzzy system helps the designer propose a tailored interface.
Relationship between input and output elements

- The attitude element measures if the user is having a change in attitude toward exercising [4].

- The knowledge element measures through challenges, the learning obtained by the elderly, and how much they fulfill their objectives [3,4].

- The engagement is measured based on the player’s behavior while they are using the application [3,4].
## Personality traits

<table>
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<tr>
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<td>Attitude</td>
<td>Knowledge</td>
<td>Engagement</td>
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<td>Neuroticism (N)</td>
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| Neuroticism (N) | Low | Low | Low |
| Agreeableness (A) | Low | Med | Low |
| Openness (O) | Med | Med | Med |
| Conscientiousness (C) | Med | High | High |
| Extraversion (E) | High | High | High |

- They are not attracted to learn and try new things.
- They are not attracted to technology; however, some of them are barely attracted to learn new things.
- Can or cannot be attracted to use Internet.
- Attracted to learn and engage in activities, but they require to be convinced on the usefulness of the technology.
- They are extremely attracted to learn and try new things. They are a pro-technology user.
3. Evaluate phase

The HMI is proposed so the end user interacts with the application.

This phase provides continuous feedback to the user and the knowledge base to determine whether the user is engaged or if adjustments are required.
Results

Openness

Personality trait

Conscientiousness
Results
Results

- Social Interaction
- Leaderboard
- Challenges
- Rewards
- Physical Activity

- Daily Challenge:
  - Do Squat walking to the windows and check if they are closed
  - Win coupons
  - Rewards

- Coupons:
  - Exchange them for products

- Tips:
  - Social Interaction
  - Challenges

- Personality trait: Agreeableness

Following Schedule: HOME

Temperature: 21°C
Humidity: 50%
Conclusion

• This framework facilitates the adoption of HMI by taking advantage of a connected device that provides elderly people with an interface according to their personality characteristics.

• This interface teaches, engages and motivates the elderly achieve a healthier lifestyle.

• The customizing method for each type of personality trait is by using fuzzy logic that defines the gamification elements required to promote exercise in the elderly and social interaction.
Conclusion

• This framework interacts with a single device; however, further research is needed to propose interaction between devices.
  • It can be optimized by applying an Artificial Neural Network that analyzes and considers the user’s needs and expectations.

• Moreover, the interface only considers the elderly as the main interactor; thus, this interface is not customized for younger users.
  • Besides, the HMI can be optimized using the principles for interaction design to propose a more appealing interface.

Future work

• Design the interface considering the Nielsen’s heuristics design.

• Use an ANN for the collected data in the knowledge base step.

• Validate the design interface with the elderly users.

• Launch the app in the market.
Thank you

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References


References


